



Figure 6. Growth indices (lunar days) and SST fitted with a Gaussian function. The dashed lines indicate the upper and lower growth temperature thresholds in *Chione (C.) cortezi* and *Chione (C.) fluctifraga*.

Growth breaks accompanied by dark lines on the exterior shell surface are commonly observed within the winter and summer bands. Furthermore, some specimens exhibit a spawning break in late spring.

Microgrowth increments form with tidal rhythms and are useful for dating special events (summer, winter, tidal cycles, storms, spawning, etc.).

Maximum growth rates occur during April to June and again during October. Growth occurs between February and December and is suppressed by temperature extremes both during the cold season and the hot summer period (mid July to mid September).

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The Influence of Hunger and Olfactory Cues on the Feeding Behavior of the Waved Whelk, *Buccinum undatum*, on the Blue Mussel, *Mytilus edulis*

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Abstract. A marine prosobranch gastropod, the waved whelk *Buccinum undatum*, is a ubiquitous predator in the North Atlantic. Previous studies have shown the whelk's diet to consist primarily of bivalve mollusks that the whelk can open using the lip of its shell as a wedge. This experiment investigated the circumstances under which whelks will attempt to feed upon the blue mussel *Mytilus edulis*. Whelks did not attempt to feed upon intact mussels after a period of starvation of 2 weeks, but were significantly more likely to attempt to feed after 6 weeks starvation. However, because of the mussel's ability to close so tightly, this was usually unsuccessful. Whelks starved less than 6 weeks attempted to feed only on mussels that had sustained tissue damage. Whelks were also attracted to water from injured mussels. This suggests that, despite the relatively high abundance of blue mussels, whelks feed on these mussels only opportunistically. This supports the argument that *B. undatum* is primarily a scavenger and has only limited success as a predator upon healthy bivalves.

INTRODUCTION

The marine prosobranch gastropod, the waved whelk *Buccinum undatum* (Linnaeus, 1758), is abundant in the North Atlantic. It tolerates a wide range of salinity and is found in depths as shallow as the mean low water mark and as deep as 1000 m (Brock, 1936; Fretter & Graham, 1962). It is considered to be a carnivore with a tendency to scavenge (Blegvad, 1915). Prior studies of stomach analysis have shown the whelk's diet to be dominated by bivalve mollusks (Nielsen, 1975). After an extensive study of *Buccinum* predation on many species of bivalves, Nielsen (1975) concluded that only rarely were the whelks able to overcome healthy bivalves of most species—including *Mytilus edulis*, the blue mussel. The whelk's method of attack is to crawl upon the shell and orient itself so that the anterior margin of the foot is in contact with the ventral edge of one of the shells of the bivalve. If the bivalve is open after this procedure, or if it reopens again after the whelk has settled, the whelk suddenly contracts and forces the lip of its shell in between the valves of the bivalve, preventing its closure. If the resulting opening is large enough, the whelk will then insert its proboscis and begin tearing flesh with its radular apparatus (Nielsen, 1975). Nielsen observed that *Buccinum* was rarely able to overcome healthy bivalves of most species. *Mytilus edulis* (Linnaeus, 1758) and *Modiolus modiolus* (Linnaeus, 1758) were able to close tightly enough that the whelks usually gave up any attempts to

open and crawled away. At times during an attempt to open, the mussels would close so tightly upon the lip of the whelk's shell as to cause it to break. One can find many whelks in a population with such scars, indicating that the process of preying upon healthy bivalves is difficult, dangerous, and potentially energetically expensive.

This experiment examined the circumstances under which whelks will attempt to feed on blue mussels. I examined their motivation to feed after 2 and 6 weeks of starvation to test the hypothesis that whelks should only attempt to feed upon healthy blue mussels after a sufficient period of starvation. I also examined the differences between whelk feeding attempts on mussels that had sustained tissue damage and those that had not sustained tissue damage. Finally, I examined the olfactory cues necessary to stimulate feeding behavior.

MATERIALS AND METHODS

Whelks were collected from the subtidal Gulf of Maine waters in the vicinity of the Isles of Shoals, New Hampshire; along the coast of New Castle, New Hampshire; and in Eastport, Maine. They were kept in filtered seawater at 10°C. Each whelk was used once in experiments and then released. The prey species *Mytilus edulis* was collected from intertidal and subtidal locations along the New Hampshire and Maine coastlines. Prey specimens were also kept in filtered seawater at 10°C. Mussels used were between 1.2 cm and 6.3 cm in length.

The whelks were fed fresh, pre-opened *M. edulis* at a designated time prior to each experiment. This was followed by a period of food deprivation to establish a uniform level of hunger in all whelks used in that particular trial.

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